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Nutrient Management Act 2002

CONSTRUCTING AN EARTHEN LIQUID NUTRIENT OR RUNOFF STORAGE FACILITY

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The following document provides recommendations to address the construction of an earthen liquid nutrient storage or runoff storage facility as required by the Nutrient Management Act, 2002, (NMA) and the associated Regulation O. Reg. 267/03 (as amended to O. Reg. 511/05). *Figure 1* shows a lined, earthen storage facility.

FIGURE 1. This earthen storage facility has been equipped with a secondary containment liner to provide additional protection for surface and ground water.

SCOPE

This Factsheet applies to a permanent earthen storage facility having either:

- 14 or more days of storage capacity (for the associated facility) or
- a maximum depth of liquid nutrients of 100 mm (4 in.) or more.

KEY POINTS

- Earthen nutrient storage facilities without any incorporated concrete structure(s) are typically not deemed to be a structure in Ontario and consequently do not require a building permit; however the Nutrient Management Act regulates their siting and construction.
- At least 2 levels of underground protection are required for these storage facilities.
- The above ground portion must have secondary containment or appropriate landscape features.
- Most of the design must be carried out under the supervision of a professional engineer. Some aspects of the design may involve a professional geoscientist.
- Proper setbacks from sensitive features such as wells, surface water and conflicting uses must be met.
- Any perforated tile drain close to the storage must be removed unless it is required for a foundation drain.
- If any component of the facility is constructed of concrete, that component must be designed and constructed using the concrete and steel storage specifications (see OMAFRA Factsheet 06-001, *Constructing a Permanent Concrete or Steel Liquid and Runoff Storage Facility* or other applicable standards). This may trigger the need for a building permit.

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SIZING

For a regulated farm the minimum capacity of the storage must:

- include precipitation directly entering an open-top storage of 2.27 mm/day (example: if the storage is designed for 240 days of capacity, the precipitation input should be 2.27 x 240 days or 0.55 m over the surface area of the storage)
- include a freeboard[1] of 0.30 m
- include 240 days of manure and bedding production[2] from attached livestock facilities with the following exceptions:
  - where the farmer sends some of the manure to a broker and the aggregate storage capacity of the broker and the farmer is 240 days (e.g. a layer chicken operation has an agreement with a broker who can provide 60 days of storage. The manure storage at the layer chicken operation would only need to be designed for 180 days)
  - where the period of use of the barn is less than 240 days (e.g. a beef feeder operation houses the animals for 180 days in the barn from Nov. 1 until they go to pasture on May 1. The manure storage would only need to be designed for 180 days)
  - where the farmer's nutrient management plan permits lesser periods of storage, (e.g. a NMP demonstrates that manure can be applied at a frequency that is less than 240 days). **NOTE: for liquid manure storage this can only be used if the number of farm animals on the farm unit has not increased since Sept. 30, 2003** or
  - where the farmer's nutrient management strategy permits lesser periods of storage via the use of transfers out of the farm unit (e.g. a dairy farm transfers its manure off-site every three months to another farm unit. The manure storage at the dairy farm would only have to be designed for 3 months).

[1] Freeboard is an additional depth of storage required to deal with wave action due to wind or agitation and to provide a safety factor to address unexpected circumstances (e.g. excessive rainfall, leaks in water system, etc.). It is added to the calculated depth required for manure production and precipitation.

[2] The manure and bedding production must be based on numbers shown in Table 3.1 of the Nutrient Management Protocol (note MSTOR, a computer program developed by OMAFRA will include these numbers and can be used to complete the calculations.)

SITING

The following distances (from the top of the inside sloping face of the storage) must be met:

- **Well setback** – the NMA Regulation requires that any new or expanding storage be at least:
  - 15 m from a drilled well that has a depth of at least 15 m and a watertight casing that extends to a depth of at least 6 m below ground level
  - 100 m from a municipal well and
  - 30 m from any other well.

- **Flow path requirement** – the NMA Regulation specifies that a farm constructing or expanding any nutrient or runoff storage, must be at least 50 m away from surface water or a tile inlet or have a flow path that is at least 50 m (165 ft.) long. The flow path is the distance over ground any liquids would have to flow from the storage before entering surface water or a tile inlet. This flow path does not always follow a straight line as illustrated in *Figure 2.*

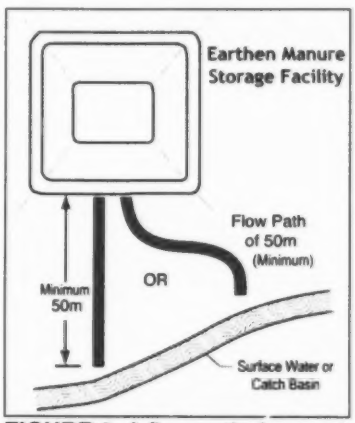

FIGURE 2. A flow path does not always follow a straight line. This required flow path is used to provide opportunities for flow control in the event of a spill.

- **1 in 100 Flood Line** – The NMA Regulation requires the storage to be constructed above any one in 100 year flood line established by a municipality or conservation authority (if the municipality or conservation authority has established such flood lines) unless a permit for the storage is issued under Section 28 of the Conservation Authorities Act.

- **Tile drains (field)** – All perforated drains within 15 m (50 ft.) must be located, intercepted and removed. Any flow from a field drainage system or piped municipal drain must be redirected away from the storage.

- **Tile drains (structural)** – The following two options can be used to manage water from a perforated foundation drain within 15 m of a manure storage facility:
  - any perimeter drain for the storage must run through an observation and shutoff station prior to entering another drainage system or surface water. This special catch basin has 2 purposes. It can be used to detect leakage from the storage to the foundation drains. In addition, it is used to shut off the flow and allow steps to be taken to identify and deal with the leakage. *Figure 3* shows a typical observation and shutoff station used to provide access to the tile drain.
  - collect the foundation drain water and discharge it to a treatment system.

SETBACKS NOT SPECIFIED IN THE NMA REGULATION

Minimum Distance Separation (MDS II) Formula

- MDS II determines minimum separation distances between proposed new, enlarged or remodeled livestock facilities and/or permanent manure storages and other existing or approved development (e.g. neighbouring houses, areas zoned residential, lot lines, road allowance, etc.)
- MDS II is triggered when a building permit is required, but because earthen storages are not considered to be a building, they do not require a building permit. However, this does not exclude them from the requirement for siting according to the MDS formula. Best Management Practices recommend the MDS formula be followed in all cases and this is backed up by the Provincial Policy Statement, 2005, policy number 1.1.4.1 (c):
  - 'New land uses, including the creation of lots, and new or expanding livestock facilities shall comply with the minimum distance separation formulae.'
- The term livestock facility is defined in the new MDS-2005 as:
  - 'Permanent structures with livestock-occupied portions, intended for the keeping or housing of livestock, including feedlots, and containing one or more barns or structures, Includes manure storages, whether associated with a livestock facility or not....'
- For more information, contact your Nutrient Management Consultant or local OMAFRA engineer.

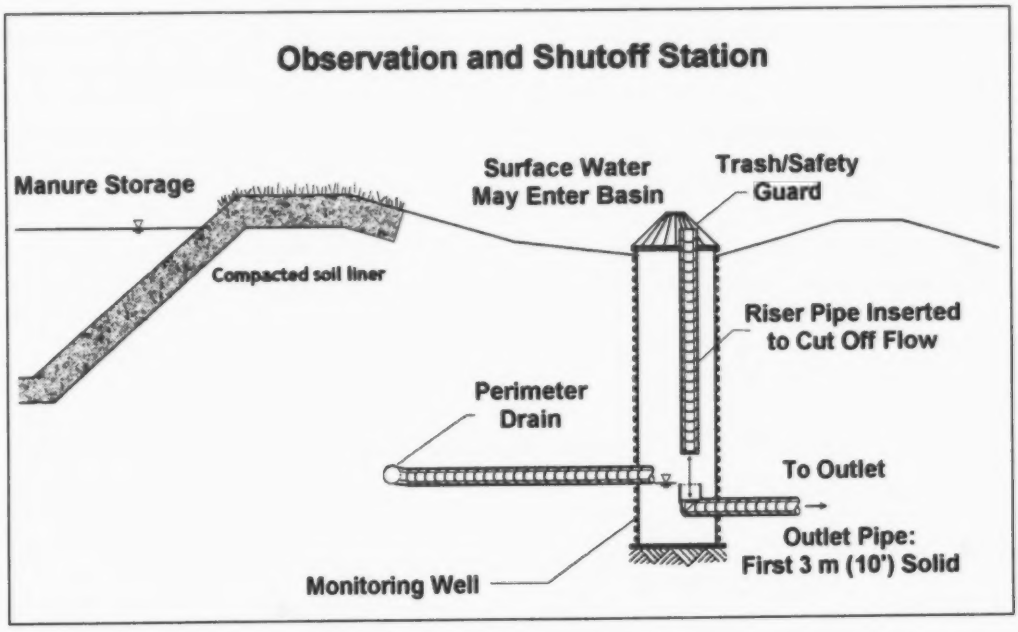

FIGURE 3. An observation and shutoff station is used to provide access to a perimeter drain if required. Possible contaminated flow can be observed and blocked. Steps can then be taken to address the situation.

Other Municipal Setbacks

- Contact your municipality for more information on other required setbacks

PROFESSIONAL INVOLVEMENT

For the construction or expansion of a permanent liquid nutrient storage facility [O. Reg. 267/03 [as amended to O. Reg. 511/05]] requires that professionals complete the following:

- **Design** — a professional engineer must complete the design, including any monitoring system (if installed).

- **Site investigation** – a professional engineer or a professional geoscientist must carry out a site characterization assessment.

- **Supervision** – the construction or expansion must take place under the supervision of a professional engineer. This supervision process has been shown to be very important in the construction of a liquid manure or nutrient storage system.

- **Commitment certificate** – the engineer must sign the Engineer's Commitment Certificate (see Appendix B) prior to the construction. The farmer must submit this with the Nutrient Management Strategy.

- **Additional requirements** – other municipal and provincial requirements may need to be addressed on a site-specific basis. For more information, contact your local building official.

SPECIFIC CRITERIA REQUIRED BY THE NMA REGULATION

- **General design** – the facility, including any associated plumbing systems used to transfer manure or liquid nutrients, must be "designed to minimize leakage, minimize corrosion and to be structurally safe and sound." [O.Reg. 267/03 as amended: sentence 71. (1)(b)]

- **Site requirements** – There are two options for earthen, liquid nutrient storage facilities:

  - **Option 1 – Storage for liquid agricultural source materials (excluding manure):** Must satisfy the criteria as specified in *Figure 4*. The Regulation specifies details regarding interior surface treatment, soil anomalies and above-ground berm construction. For example, the soils that form the inner surface must be disked to a depth of 150 mm and recompacted to meet a hydraulic conductivity of no more than 1×10^{-8} m/sec.

  - **Option 2 – Storage for liquid agricultural source materials (including manure):** Must satisfy the criteria as specified in *Figure 5*. In addition to the 2 m of hydraulically secure soil, this option requires the installation of a compacted soil, geo-synthetic or synthetic liner. Liner installation details are specified in the NMA Regulation. For example, the Regulation specifies that:

    - liners must be continuous under the storage facility and must extend to a level equal to the surrounding ground surface, unless the designer specifies otherwise.

- **Compacted soil liner** – if this type of liner is used it must be constructed:

  - using a minimum of 6 layers, of 150 mm thick material on the inside sloping surfaces
  - using a minimum of 4 layers of 150 mm thick material on the floor surface.

- **Hydraulic conductivity** – it is recommended that a liner should have a hydraulic conductivity of no more than 1×10^{-9} m/sec.

- **Site investigation** – is required for all permanent, liquid nutrient storage facilities. (*See Appendix A*)

- **Secondary containment** – If the liquid level in the storage facility is partially or wholly above the surface of the surrounding soil, the following options apply:

  - a professional engineer can determine that the storage and landscape features around the facility are adequate to ensure that a secondary containment system is not required; or
  - the designer incorporates a secondary containment system, with a capacity of 110% of the above ground portion of the volume of material stored.

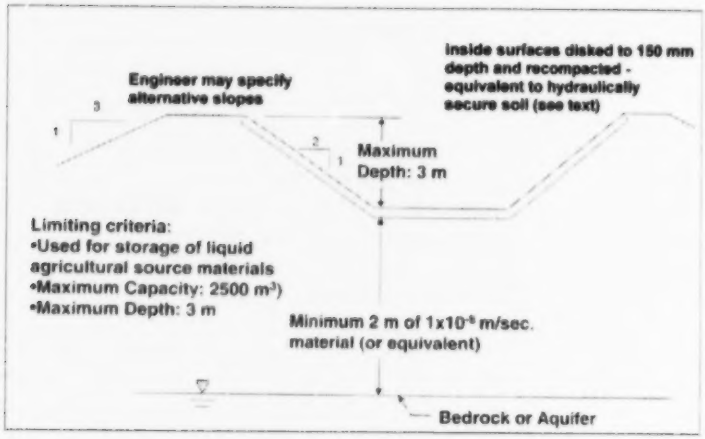
Inside surfaces disked to 150 mm depth and recompacted - equivalent to hydraulically secure soil (see text)
Engineer may specify alternative slopes
3
1
2
1
Maximum Depth: 3 m
Limiting criteria:
•Used for storage of liquid agricultural source materials
•Maximum Capacity: 2500 m³)
•Maximum Depth: 3 m
Minimum 2 m of 1x10⁻⁶ m/sec. material (or equivalent)
Bedrock or Aquifer

FIGURE 4. Design criteria for smaller runoff storage facilities, storing liquid agricultural source materials other than manure.

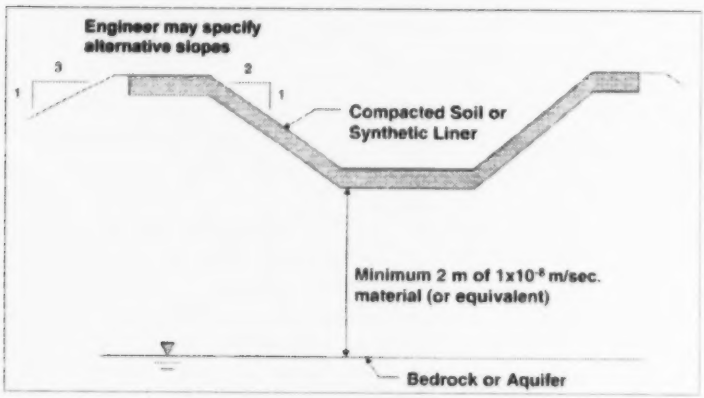

FIGURE 5. Design criteria for storage facilities, storing liquid nutrients and/or manure.

- **Transfer systems** – all connections in a liquid transfer system must be installed using specifically designed fittings and gaskets that are compatible with the pipe material
  - all pipes entering a liquid manure facility must have a flexible, watertight gasket or membrane installed between the pipe and the floor or wall of the storage structure to serve as an anti-seepage collar
  - any transfer system having an opportunity to backflow to the pump or pump-out chamber must have both a primary and secondary shutoff valve.

- **Floor transfer systems** – must be constructed of concrete and be capable of containing and transferring liquid to a storage facility. A floor transfer system does not include:
  - areas within the barn, designed to house livestock, but not intended to collect liquid manure
  - areas under dairy free-stalls
  - feed trough areas
  - floors under manure pack areas.

- **Ventilation** – All covered storage systems must have a ventilation system that may be either a powered or natural ventilation system to prevent the accumulation of corrosive or noxious gases.

- **Alternative design** – An engineer can produce a design that is equivalent to or makes use of materials that are equivalent to those referred to in the Act or Regulation.

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APPENDIX A: SITE CHARACTERIZATION/ INVESTIGATION CRITERIA SPECIFIED IN THE REGULATION

Site characterization is a process followed for all new, permanent liquid manure storage structures to determine how much protection is provided by the natural environment on the proposed building site. A basic site characterization evaluation considers the soil type and water table location, etc. In cases where the natural site does not provide sufficient protection, it may be necessary to use a synthetic liner, a geo-synthetic liner or an engineered soil (usually clay) liner to enhance the protection for surface and/or ground water.

You must hire a professional engineer or professional geoscientist to make the site assessment. OMAFRA can provide a partial listing of engineering and geotechnical companies who are familiar with agricultural projects. These individuals will take soil samples and investigate the location of permanent and naturally or artificially occurring water tables. These tests can be carried out using a boring machine or a backhoe/excavator. The machine must be capable of boring or excavating to a minimum depth of 1.5 m below the lowest excavation for the structure. If an earthen floor is desired, the depth of investigation must be 2.5 m below the lowest excavation for the structure. One borehole or excavation is required per 1,000 m^2 of ground floor area for the facility being constructed. The engineer or geoscientist may require more samples to be taken, due to site conditions.

The soil samples must be evaluated by a geotechnical laboratory to determine their physical properties. The geotechnical evaluation will determine if the soil provides a level of protection equivalent to OMAFRA's guidelines. These guidelines are listed below:

- The saturated hydraulic conductivity of the soil is a measure of how rapidly water (and nutrients) can move through the soil. For protection of the environment, slower is better. Hydraulically secure soil has a maximum saturated hydraulic conductivity of 1×10^{-8} m/sec. An indication of the saturated hydraulic conductivity of the soil can be obtained by several means:
  - by following a standard in-situ or laboratory testing procedure according to American Society of Testing and Materials (ASTM) or Canadian Standards Association (CSA) standards or
  - by evaluating soil particle size and Atterberg test data. The following are the recommended ranges that will provide the required level of protection.

Particle size analysis

Fines:	≥ 50%
Clay Content:	≥ 20%
Sand Content:	≤ 45%
Gravel Content:	≤ 50%

Atterberg Limits

Plasticity Index (PI):	11% ≤ PI ≤ 30%
Liquid Limit (LL):	30% ≤ LL ≤ 60%

A professional geoscientist may alternatively provide data or a design that will provide a level protection that is an equivalent to the above alternatives.

An important part of a site characterization study is to determine the level of the water tables in the vicinity of the proposed liquid nutrient storage facility. There can be several water table levels on a building site. Some of these occur naturally, while others may have been caused by other construction projects. Constructing any part of a storage facility below a water table is not advised. In some cases, a water table can be artificially lowered by providing a drainage system surrounding the storage. This drainage system would require a monitoring catch basin to show that no direct contamination is occurring.

In some problem soils, the best alternative may be to make use of a synthetic, geosynthetic or engineered soil liner to provide secondary containment. With two levels of protection for the environment, the protection offered by the proposed building site becomes less critical.

APPENDIX B - ENGINEER COMMITMENT CERTIFICATE – FORM A

Project: _____
Name / Location

This is to Certify that I: _____ _____ _____

Owner Signature Date

understand that under the Nutrient Management Act, 2002, I am required to retain engineering services for specific projects and situations. Therefore I have retained the following Professional Engineer:

_____ _____ _____

Engineer's name Signature Date

to undertake the overall coordination and completion of the engineering design and general review of construction; **or**

I have retained the following Professional Engineers to provide engineering services for the following components of the engineering design and review of construction:

Design Component	Engineer's Name	Engineer's Signature	Address	Phone
Site Characterization * - sub-surface information, soil properties, water table and bedrock location (if critical)				
Liquid Storage Facilities – drawings and design details for liquid storage construction				
Solid Storage Facilities – drawings and design details for solid storage construction if applicable				
Earthen Storage Facilities – drawings and design details for earthen storage construction				
Synthetic or Natural Liner – design details, including details of inspection and testing of seams.				
Transfer Systems – drawings and design details for connections, materials, etc.				

Do you know about Ontario's new Nutrient Management Act?

The provincial Nutrient Management Act (NMA) and the Regulation 267/03 regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the NMA, call the Nutrient Management Information Line at 1-866-242-4460, e-mail *nman@omafra.gov.on.ca* or visit *www.omafra.gov.on.ca*.

Factsheets are continually being updated so please ensure that you have the most recent version.

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